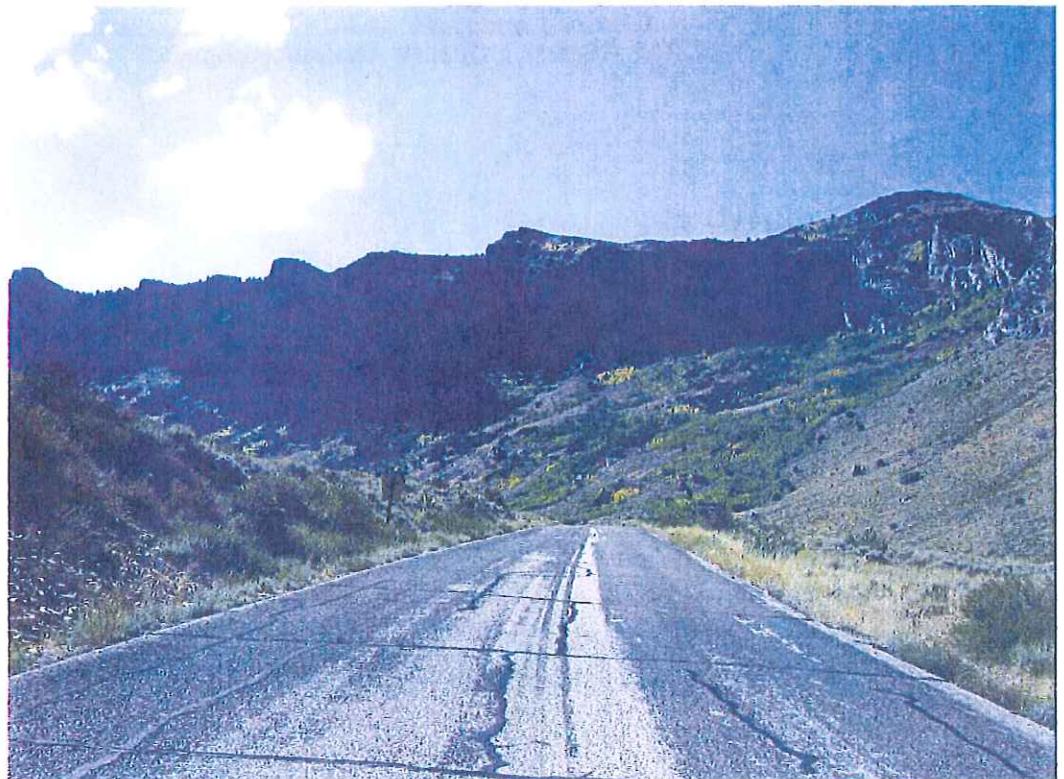


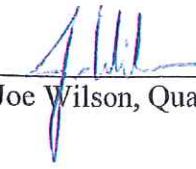
HUMBOLDT-TOIYABE National Forest
NV PFH 31(1) LAMOILLE CANYON ROAD

PAVEMENT REPORT
Report # 09-04



NV PFH 31(1) Lamoille Canyon Road

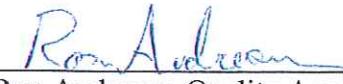
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TABLE OF CONTENTS

I. INTRODUCTION	1
II. CLIMATE	1
III. EXPLORATION.....	2
IV. EXISTING PAVEMENT & SOILS.....	2
V. TEST RESULTS.....	2
VI. PAVEMENT DESIGN CALCULATION INPUTS	7
VII. PAVEMENT RECOMMENDATIONS & DISCUSSION.....	7
VIII. MATERIALS RECOMMENDATIONS	9

APPENDICES

- A – Location Map
- B – Laboratory Reports
- C – Photographs
- D – DARWin Pavement Design
- E – PG LTTPBIND Software
- F – Visual Classification Summary
- G – Price estimations and assumptions
- H – Preliminary Pavement Recommendation Memo

I. INTRODUCTION

This report is written to document road conditions for the planned 2009/10 project, NV PFH 31(1) LAMOILLE CANYON ROAD. The project is located approximately 20 miles southeast of Elko, Nevada within the Ruby Mountain Ranger District of the Humboldt-Toiyabe National Forest. Major improvements were undertaken on the road in the early 1970s. These improvements included realignment and paving. During the week of September 28th 2008, a pavement and subgrade soil investigation was conducted from the NV 227 Intersection to the top of the canyon, approximately 12 miles. A geotechnical report was published in February 2009 (#NV-FX-0031-09-01). The Preliminary Pavement Recommendations Memo issued in December 2008 provided pavement structural section recommendations. The pavement recommendations are now finalized in this report, Part VII Pavement Recommendations and Discussion.

II. CLIMATE

The warmest month of the year is July with an average high of 85°F. December and January are the coldest with an average low of 14°F. Total precipitation for the year averages 14.05 inches. May on average is the wettest month with 2.03 inches, while July is the driest with 0.47 inches of precipitation. It should be noted that this weather data is recorded at the "Lamoille Miller Ranch" at an elevation of ≈5,400 feet, or at the bottom of the canyon. The planned Lamoille Canyon Road begins at an elevation of ≈5,900 feet and climbs to the top of the canyon or ≈8,800 feet.

TABLE 1: Temperatures are in °F and precipitations are in inches

Month	Average HIGH	Record HIGH	Average LOW	Record LOW	Average PRECIP.
January	37	64	14	-17	1.26
February	42	67	18	-23	1.13
March	49	76	23	-6	1.60
April	56	82	28	3	1.40
May	65	91	35	14	2.03
June	75	97	42	22	1.15
July	85	101	47	30	0.47
August	84	99	46	25	0.53
September	75	92	38	14	1.11
October	62	83	29	1	1.10
November	47	73	21	-12	1.26
December	38	62	14	-16	1.01

III. EXPLORATION

A pavement and subgrade soil investigation occurred on September 30th thru October 2nd, 2008. Prior to the initiation of the investigation, the CFL Survey crew marked and labeled the borings every $\frac{1}{4}$ of a mile in the center of the roadway. The pavement and subgrade investigation used a truck mounted drill rig, CME 45 by Technicon Engineering Services, Inc. of Fresno, CA, to auger through the existing pavement and to continue into the subgrade from 1 foot to 5 feet in depth. CFL personnel logged the borings; this included among other things depth of boring, visual soil classification, pavement thickness, pavement distress, and road width.

IV. EXISTING PAVEMENT & SOILS

Existing pavement was drilled at $\frac{1}{4}$ -mile increments, therefore differences in site conditions could exist between borings. The roadway averages 25 feet in width along the entire route. Pavement thickness varies between 4 and 6 inches, with a vast majority of the recorded thicknesses being 5 inches in depth. In general soil conditions improved as you travel up the canyon. At the mouth of the canyon the soil conditions are poor, sandy clay (R-Value, 6), at the top of the canyon the soil improves, sand with silt and gravel (R-Value, 70's). There are indications the road is deteriorating and at various locations within the roadway road facilities are nearing the end of its design life. Signs of this deterioration include the numerous visible pavement cracks, and deteriorated pavement edges. There have been multiple surface treatments applied over the life of the roadway. These treatments start and stop throughout the entirety of the road. Visible pavement distress appears to be age or drainage related and not indicative of subgrade distress.

Shallow bedrock does exist at numerous locations as well as cobbles at depths typically immediately below the existing pavement. A note of caution should clearly state on the typical plan sheet that the cobbles and shallow bedrock could impact the pulverization process.

See TABLE 2 below for summary of investigative findings

V. TEST RESULTS

See TABLE 2 below for summary of test results

NV PFH 31(1) Lamouille Canyon Road

TABLE 2

Boring	~MP	Depth	Pavement Width	Material (visual)	Pavement Distress	Sample	% Moist.	Soil Classification	R-Value
B-1 RT	0.00	--	25"	---	intersection, high severity block cracking, transverse cracking every 10'	---	--	--	--
B-2 RT	0.25	24"	25"	5" HACP, bottom 1" stripping 19" Native Base, sandy gravelly clay (-1.5")	high severity block cracking, transverse cracking every 10'	---	--	--	--
B-3 RT	0.50	18"	25'2"	5" HACP, bottom 1" stripping 13" Native Base, gravelly clay med PI (-1")	high severity block cracking, alligator cracking, and transverse cracking every 10'	---	--	--	--
B-4 RT	0.75	30"	25"	5" HACP, bottom 2" stripping 2" Native Base, sandy gravelly clay (-1.5") 23" clay, med-high PI	high severity block cracking, alligator cracking	Baggie 1, 7-24"	12.8	A-6(7) CL	--
B-5 RT	1.00	18"	24'6"	5" HACP, bottom 1" stripping 10" Native Base, sandy gravelly clay med PI (-1.5") 3" Base, sandy gravel	high severity block cracking, alligator cracking 1WL	Baggie 1, 7-24"	12.8	--	--
B-6 RT	1.25	36" cob at 36"	25"	4" HACP, bottom 1" stripping 4" Base, native gravel 18" Native Base, sandy gravelly clay 10" Clay, Dark, high PI	high severity block cracking with crack seal, alligator cracking 1WL	Bucket 1, 8-24" Baggie 2, 8-18"	9.4	A-6(4) SC	6
B-7 RT	1.50	10" cob at 10"	25'9"	4.5" HACP, bottom 1.5" stripping 2.5" Base, sandy gravel 3" Native Base, sandy gravelly clay (-2")	high severity block cracking, no crack seal	---	--	--	--
B-8 RT	1.75	24"	25"	5" HACP, bottom 1.5" stripping 19" Native Base, sandy gravel low PI	high severity block cracking with crack seal	Baggie 3, 5-24"	5.4	A-1-1b(0) SM	--
B-9 RT	2.00	24"	25"	5" HACP 5" Base, sandy gravel 14" Sub-Base, silty sandy gravel low PI	high severity block cracking with crack seal	---	--	--	--
B-10 RT	2.25	12" cob at 12"	29"	5" HACP 7" Native Base, sandy gravel low PI	high severity block cracking, grass growing up through, no crack seal	---	--	--	--
B-11 RT	2.50	18" auger ref	29'6"	6" HACP, bottom 1" stripping 5" Native Base, sandy gravel 7" Shale Rock	high severity block cracking with crack seal	Baggie 4, 6-18" Baggie 5, 6-18"	5.0	--	--
B-12 RT	2.75	60" cob at 24"	25'6"	5" HACP, bottom 1" stripping 2" Base, sandy silty gravel 53" Sub-Base, sandy clayey gravel	high severity block cracking with crack seal	Bucket 2, 7-60" Baggie 6, 7-24"	5.0	A-2-4(0) SC	25
B-13 RT	3.00	24" cob at 24"	25'10"	5.5" HACP, bottom 0.5" stripping 1" Base, sandy gravel 17.5" Native Base, sandy clayey gravel	high severity block cracking with crack seal	---	--	--	--
B-14 RT	3.25	18" auger ref	25"	5" HACP, bottom 1" stripping 13" Native Base, sandy clayey gravel (-2")	high severity block cracking with crack seal	---	--	--	--
B-15 RT	3.50	24"	25"	5.5" HACP, bottom 1.5" stripping guardrail 4" Base, sandy gravel 15.5" Native Base, sandy clayey gravel (-2")	high severity block cracking with crack seal	---	--	--	--
B-16 RT	3.75	18"	25'4"	5.5" HACP, bottom 2" stripping 3" Native Base, sandy silty gravel 9.5" Sub-Base, sandy clayey gravel (-2")	high severity block cracking with crack seal	Baggie 7, 8.5-18"	4.8	--	--
B-17 RT	4.00	30" cob at 24"	24'3"	6" HACP, bottom 1" stripping guardrail 24" Native Base, sandy clayey gravel	high severity block cracking with crack seal	Baggie 8, 6-24"	5.6	--	--

NV Pr H 31(1) Lamoille Canyon Road

TABLE 2

Boring	~MP	Depth	Pavement Width	Material (visual)	Pavement Distress	Sample	% Moist.	Soil Class.	R-Value
B-18A RT	4.25	18"	25'	5.5" HACP, bottom 2.75" stripping 12.5" Native Base, sandy clayey gravel (-3")	high severity block cracking with crack seal	--	--	--	--
B-18 RT	4.50	42"	25'	6" HACP, bottom 2" stripping 3" Native Base, sandy silty gravel	high severity block cracking, no crack seal	Bucket 3, 6-42" Baggie 10, 6-42"	4.6	A-1-B(0) SC-SM	35
B-19 LT RT	4.75	18"	24'10"	5" HACP, bottom 1.25" stripping 3" Base, sandy gravel 10" Native Base, sandy clayey gravel (-2")	medium severity block cracking, no crack seal	--	--	--	--
B-20 LT	5.00	12"	36'	5" HACP, bottom 1.5" stripping 7" Native Base, sandy clayey gravel (-2") at turnout	med-high severity block cracking, alligator cracking, no crack seal	--	--	--	--
B-21 RT	5.25	20"	25'	5" HACP, bottom 1" stripping 2" Base, sandy gravel 13" Native Base, sandy clayey gravel	medium severity block cracking, no crack seal	--	--	--	--
B-22 RT	5.50	10"	26'	5" HACP, bottom 1" stripping 5" Native Base, silty clayey gravel at pullout	high severity block cracking with crack seal	--	--	--	--
B-23 RT	5.75	12"	25'	5" HACP, bottom 1.5" stripping 7" Native Base, sandy gravel (-2") auger ref	medium severity block cracking, no crack seal	--	--	--	--
B-24A RT	6.00	12"	25'	5.5" HACP, bottom 1" stripping 6.5" Native Base, sandy silty gravel (-2") auger ref	light severity block cracking, no crack seal	--	--	--	--
B-24 RT	6.25	42"	25'	6" HACP, bottom 1" stripping 3.4" cobbles directly below pavement 36" Native Base, sandy silty gravel (-2")	high severity block cracking, no crack seal	Bucket 4, 6-42" Baggie 11, 6-42"	2.9	--	--
B-25 RT	6.50	14"	24'6"	5" HACP, bottom 1" stripping 2" Base, leveling sand 7" Native Base, sandy silty gravel (-2")	light severity block cracking, no crack seal	--	--	--	--
B-26 RT	6.75	30"	24'6"	5" HACP, bottom 1" stripping 1" Base, leveling sand 24" Native Base, darker sandy silty gravel	medium severity block cracking, no crack seal	--	--	--	--
B-27 RT	7.00	20"	25"	5" HACP, bottom 1" stripping 2" Base, leveling sand 13" Native Base, sandy silty gravel (-2")	light severity block cracking, no crack seal	--	--	--	--
B-28 RT	7.25	24"	25"	5" HACP 2" Base, leveling sand 17" Native Base, sandy silty gravel (-2")	light severity block cracking, no crack seal	Baggie 12, 7-24"	4.1	--	--
B-29 RT	7.50	14"	24"	6" HACP 2" Base, leveling sand 6" Native Base, sandy silty gravel (-2") auger ref	light severity block cracking, no crack seal	--	--	--	--
B-30 RT	7.75	18"	25'	5" HACP 1" Base, leveling sand 12" Native Base, sandy silty gravel (-2")	light severity block cracking, with crack seal	Baggie 13, 6-18"	3.9	--	--
B-31 RT	8.00	11"	24"	5.5" HACP, bottom 1" stripping 1" Base, leveling sand 4.5" Native Base, sandy silty gravel (-1.5")	medium severity block cracking, medium transverse cracking, with crack seal	--	--	--	--
B-32 RT	8.25	27"	24'8"	6" HACP, bottom 1" stripping 1" Base, leveling sand 21" Native Base, sandy silty gravel (-1.5")	medium severity block cracking, medium transverse cracking, with crack seal	Bucket 5, 7-24" Baggie 14, 7-12"	3.3	A-1-B(0) SP-SM	73

NV PFH 31(1) Lamouille Canyon Road

TABLE 2

Boring	~MP	Depth	Pavement Width	Material (visual)	Pavement Distress	Sample	% Moist	Soil Class.	R-Value
B-33 RT	8.50	15" auger ref	24'6"	5" HACP, bottom 1" stripping 2" Base, leveling sand 8" Native Base, sandy silty gravel (-1.5")	medium severity block cracking, medium transverse cracking, with no crack seal	--	--	--	--
B-34 RT	8.75	10" auger ref	24'9"	5" HACP 2" Base, leveling sand 3" Native Base, sandy silty gravel (-2")	medium transverse cracking, no crack seal	--	--	--	--
B-35 RT	9.00	15" cob at 9" auger ref	25'	5.5" HACP, bottom 1" stripping 7.5" Native Base, sandy silty gravel	medium transverse cracking, no crack seal	--	--	--	--
B-36 RT	9.25	14" auger ref	25'	5" HACP, bottom 1" stripping 2" Base, leveling sand 7" Native Base, sandy silty gravel	medium transverse cracking, no crack seal	--	--	--	--
B-37 RT	9.50	12" auger ref	25'	6" HACP, bottom 1" stripping 2" Base, leveling sand 4" Native Base, sandy silty gravel	medium transverse cracking, no crack seal	--	--	--	--
B-38 RT	9.75	11" auger ref	25'	5" HACP, bottom 1" stripping 2" Base, leveling sand 4" Native Base, sandy silty gravel	snow plow scraping, medium transverse cracking, no crack seal	--	--	--	--
B-39 RT	10.00	36" cob at 9"	25'	5" HACP, bottom 1" soft 2" Base, leveling sand 29" Native Base, sandy silty gravel	high severity block cracking, high severity transverse cracking, no crack seal	Bucket 6, 7-36" Baggie 15, 7-36"	2.6	A-1-B(0) SP-SM	75
B-40 RT	10.25	12" cob at 8" auger ref	25'	5" HACP, bottom 2" soft 7" Native Base, sandy silty gravel	medium block, and transverse cracking, no crack seal	--	--	--	--
B-41 RT	10.50	15"	25'	5" HACP, bottom 1" soft 2" Base, leveling sand 8" Native Base, sandy silty gravel (-1")	medium transverse cracking, no crack seal	Baggie 16, 7-15"	6.0	A-1-B(0) SM	--
B-42 RT	10.75	15"	25'	5" HACP 1" Base, leveling sand 9" Native Base, sandy silty gravel	high severity block, transverse, and alligator cracking, no crack seal	--	--	--	--
B-43 RT	11.00	18" cob at 11"	25'	6" HACP, bottom 1" soft 2" Base, leveling sand 10" Native Base, sandy silty gravel	medium severity transverse cracking, half-moon cracks, drop off on soft shoulder	--	--	--	--
B-44 RT	11.25	18"	25'	5" HACP, bottom 2" stripping 2" Base, leveling sand 11" Native Base, sandy silty gravel (-1/2")	high severity transverse cracking, raveling, half-moon cracks	Baggie 17, 7-18"	8.5	A-1-B(0) SM	--
B-45 RT	11.50	18"	25'6"	5" HACP, bottom 1" soft 2" Base, leveling sand 11" Native Base, sandy silty gravel (-1/2")	high severity transverse cracking, no crack seal	Baggie 18, 7-18"	7.3	A-1-B(0) SM	--
B-46	—	—	—	Geotechnical Borings					
B-47	—	—	—	Geotechnical Borings					
B-48 RT	11.75	16" cob at 8"	25'	5" HACP, bottom 1" stripping 2" Base, leveling sand 9" Native Base, sandy silty gravel (-2")	severe bumps, moderate transverse cracking	--	--	--	--
B-49 RT	12.00	9.5" auger ref	25'3"	4.5" HACP, bottom 1" soft 2" Base, leveling sand 3" Native Base, sandy silty gravel	medium transverse cracking, no crack seal	--	--	--	--

NV PRH 31(1) Lamoille Canyon Road

TABLE 2

Boring	Depth	Pavement Width	Material (visual)	Pavement Distress	Sample	% Moist	Soil Class	R-value
Parking Lot-1, top of canyon	14"	--	3.5" HACP 4.5" "Road Mix" 6" Native Base, sandy silty gravel (.3/4")	--	--	--	--	--
Parking Lot-2, top of canyon	14"	--	5.5" HACP 3.5" "Road Mix" 9-12" Native Base, sandy silty gravel (.3/4") 12-14" clay	--	--	--	--	--
Pullout-1, "Aralane Shoot"	10"	--	3" HACP bottom 0.5" stripping 7" Native Base, sandy silty gravel	--	--	--	--	--
Pullout-2, "Hanging Valley"	9.5"	cob at 10' auger ref	-- 4" HACP 5.5" Base, sandy clayey gravel	--	--	--	--	--
Pullout-3, "Lyons Camp"	10"	--	3" HACP 1" Base, sandy	--	--	--	--	--
Pullout-4, "Lamoille Canyon"	5.5"	--	6" Native Base, sandy silty gravel 4" HACP 1" Native Base, sandy silty gravel	--	--	--	--	--

VI. PAVEMENT DESIGN CALCULATION INPUTS

Traffic

Traffic counts were obtained from the National Forest Service. For the pavement design calculations, average daily traffic (ADT) of 350 was used, resulting in a calculated cumulative equivalent single axel load (ESALs) of 51,793. The assumptions made in the ESAL calculations are included in appendix D.

Roadbed Soil Resilient Modulus

The soil resilient modulus was converted from R-Value, AASHTO T 190, using the following equation:

$$\text{Resilient Modulus (psi)} = 10^{[(S_1 + 18.72) / 6.24]}$$

where

$$S_1 = [(R\text{-Value} - 5) / 11.29] + 3$$

Section	R-Value	Resilient Modulus
NV 227 Intersection to Pullout (~MP-1.75)	6	3,126 psi
Pullout (~MP-1.75) to Turnout (~MP-5.0)	30	6,849 psi
Turnout (~MP-5.0) to End of Project	60	18,259 psi

VII. PAVEMENT RECOMMENDATIONS & DISCUSSION

Based on the varying subgrade soils and funding constraints, the ~12 mile project was broken into three structural sections.

NV 227 Intersection to ~MP-1.75

As determined by the above equation, a subgrade soil resilient modulus of 3,126 psi was used for the pavement design. According to the soil classifications performed, this segment contains both clay (CL), and sandy clay (SC). The existing pavement depth for this section varied between 4 and 5 inches (Appendix E). The required pavement design structural number (SN) is 2.65, for a 20 year pavement design.

The following is the recommended pavement structural section:

4.0 inches HACP

6.0 inches FDR – Pulverize

SN = 2.64

Grade Raise = 4.0 inches

Cost Estimate = ~\$450,000 per mile, paving and pulverization cost only

NV PFH 31(1) Lamoille Canyon Road

~MP-1.75 to Turnout at ~MP-5.0

As test results indicate the subgrade soils improve as you travel up the canyon. A subgrade soil resilient modulus of 6,849 psi was used for pavement design. Assorted pavement depths were recorded between 5 and 6 inches (Appendix E). The required pavement design structural number (SN) is 1.98, for a 20 year pavement design.

The following is the recommended pavement structural section:

3.0 inches HACP
6.0 inches FDR – Pulverize
SN = 2.04
Grade Raise = 3.0 inches
Cost Estimate = ~\$340,000 per mile, paving and pulverization cost only

Turnout at ~MP-5.0 to End of Project

In general, from mile post 5 to the top of the canyon, the existing pavement distress is low in severity. There are spot locations that require asphalt patching. A resilient modulus of 18,259 psi was used for pavement design. Pavement depths were logged between 4.5 and 6 inches (Appendix E).

The following is the recommended pavement structural section:

Crack Seal
Pavement patching in spot locations
Chip Seal
Grade Raise = 0
Cost Estimate = ~\$73,000 per mile, paving and pulverization cost only

Asphalt Patching

As noted above, there are spot locations that require asphalt patching prior to a surface treatment being applied. These locations are ~MP-10.75, and two locations near ~MP-11.25. A total of 400 yards² of asphalt patching should be included in the contract.

NOTE: This should be considered a 7 year maintenance treatment.

Alternative non 20-year Design Option

Due to funding constraints, an alternative to a 20-year design was requested to be explored. The option below would typically have a service life of 3 to 7 years with risks of localized failures occurring in the first year of placement. The risk should clearly be communicated to the partner agencies.

Double Chip Seal
6.0 inches FDR – Pulverize
Grade Raise = 0.75 inches
Cost Estimate = ~\$195,000 per mile, paving and pulverization cost only

VIII. MATERIALS RECOMMENDATIONS

Selection of Asphalt Binder

LTTP Bind software indicates use of PG 58-28 at 98% reliability, the standard asphalt binder for northern Nevada is PG 64-28NV. Recommend using the locally supplied binder.

Drainage, Subexcavation, and other Issues

During the field investigation of September 2008, there were no major water or drainage problems that were evident concerning the roadbed. Although no subexcavation is expected to be needed, 500 tons of subexcavation should be put in the contract to be used at the discretion of the CO.

Typical subexcavation should be 1 to 2 feet in depth; placement of a geotextile separation fabric and placement of 1 to 2 feet of select borrow on top of the fabric. The pavement structural section should then match the mainline typical section. A positive drainage system such as daylighting out to the foreslope or an edge drain system should be included. The Pavements Section can be contacted for further details if subexcavating an area becomes necessary (720-963-3532).

Recommended Bid Items:

- **40201-4700** - Hot Asphalt Concrete Pavement, Hvccm Test, Class B, Grading C or E. Estimate at 145 lb/ft³. Asphalt cement will be PG 64-28NV. Type IV Roughness should be specified.
- **40205-3000** - Antistrip will be Type III (Hydrated Lime) at 1%
- **40901-0300** - Surface treatment aggregate should be designation 1C, grading D, estimate at 27lb/ft².
- **40920-1000** - Fog Seal, use an emulsion CSS-1, CSS-1h, SS-1, or SS-1h estimate at 0.10 gal/yd².
- **40940-1300** - Chip seal emulsion shall be either CRS-2p or CRS-2l, estimate at 0.39 gal/yd².
- **41101-3000** - Prime Coat, applied to the FDR – Pulverized material prior to paving. Use an emulsion CSS-1, CSS-1h, SS-1, or SS-1h estimate at 0.27 gal/yd².
- **41106-0000** - Item for blotter control should be included at 14.75lb/ft².
- **41201-0000** – Tack Coat, HACP shall be placed in two lifts between lifts with a tack coat in between lifts. Use an emulsion CSS-1, CSS-1h, SS-1, or SS-1h, estimate at 0.10 gal/yd².

APPENDICES

A – Location Map

B – Laboratory Reports

C – Photographs

D – DARWin Pavement Design

E – PG LTTPBIND Software

F – Visual Classification Summary

G – Price Estimations and Assumptions

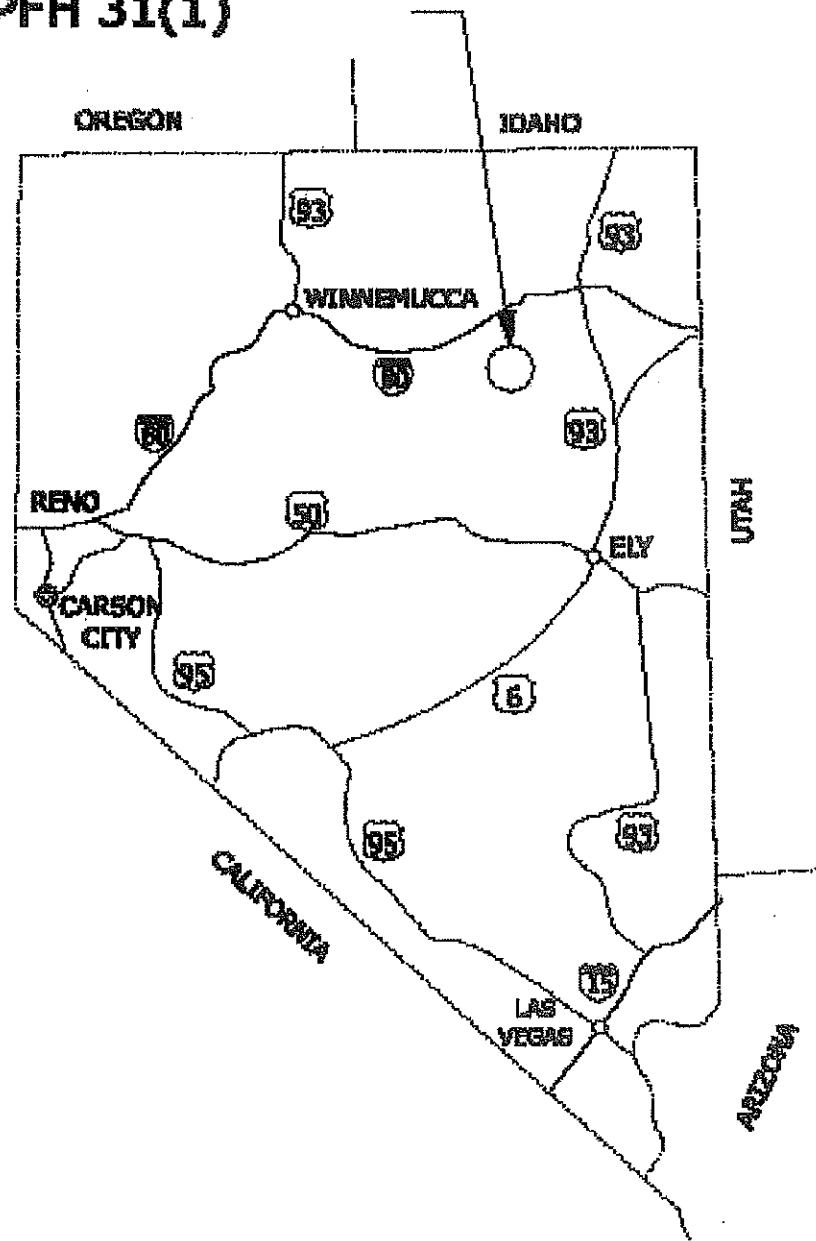
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NVPFH 31(1) Lamoille Canyon Road

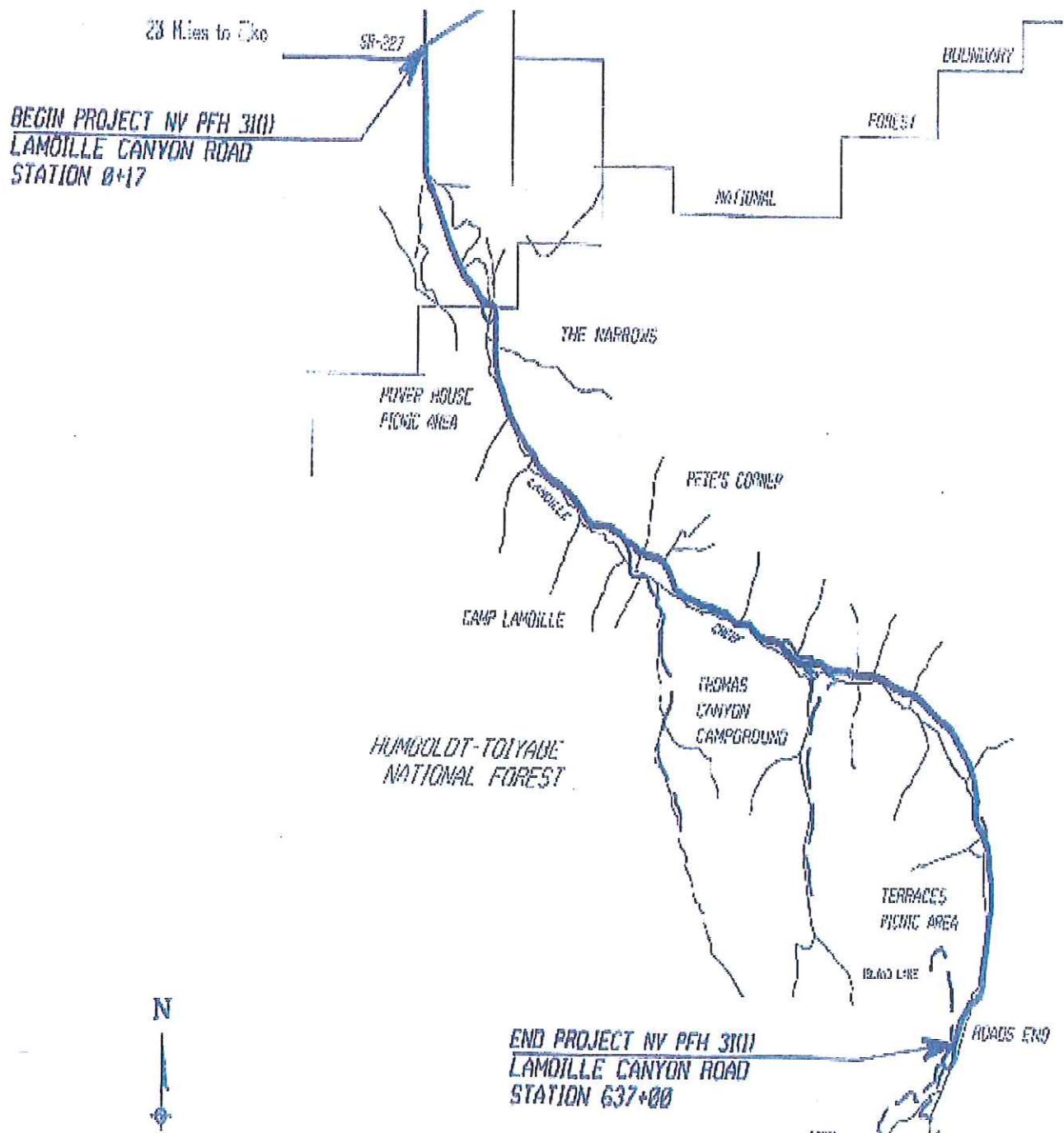
APPENDIX A – Location Map

NV PFH 31(1) Lamoille Canyon Road

PROJECT LOCATION NV PFH 31(1)



NV PFH 31(1) Lamoille Canyon Road



APPENDIX B – Laboratory Reports



U.S. Department
of Transportation
Federal Highway
Administration

Central Federal Lands Highway Division Laboratory

An AASHTO and ISO Accredited Laboratory



AASHTO R18 ISO/IEC 17025

Report of Soil or Aggregate Tests

Page 1 of 5

Project: Nevada PFH 31(1) Lamoille Canyon Road

Submitted By: Joe Wilson

Date Reported: 10/30/2008

Sample Number	Lab Number	08-1273-SB	08-1274-SB	08-1275-SB	08-1276-SB	08-1277-SB
	Boring Number	B-4	B-6	B-8	B-11	B-12
	Bag Number	MC 1	MC 2	MC 3	MC 4	MC 6
Sample Location	Station or Location					
	Offset	Right	Right	Right	Right	Right
	Depth Inches	7-24	8-18	8-24	6-11	7-24
AASHTO T 11, T 27 & T 88 Washed Sieve Analysis % Passing	3"	75.0 mm				
	1 1/2"	37.5 mm		100		
	1"	25.0 mm		94		
	3/4"	19.0 mm		90		
	1/2"	12.5 mm	100	83		
	3/8"	9.5 mm	99	79		
	#4	4.75 mm	98	72		
	#8	2.36 mm				
	#10	2.00 mm	92	62		
	#16	1.18 mm	86	55		
	#30	600 µm				
	#40	425 µm	71	41		
	#50	300 µm				
	#100	150 µm	58	28		
	#200	75 µm	52	21		
		20 µm				
		2 µm				
		1 µm				
AASHTO T 255	Moisture, %	12.8	9.4	5.4	5.0	5.0
AASHTO T 89 & T 90	Liquid Limit	38		20		
	Plasticity Index	22		3		
Soil Classification	AASHTO M 145	A-6 (7)		A-1-b (0)		
	ASTM D 2487	CL		SM		
AASHTO T 190	R -Value					
AASHTO T 288	Min. Resistivity, ohm-cm					
AASHTO T 289	pH					
AASHTO Method	Optimum Moisture, %					
	Maximum Dry Density, pcf					

Distribution:
Laboratory Num. / Project File
 Darrell Harding
QA Joe Wilson
Pavements Steve Deppmeier
Materials 1 Copy

Remarks:

Stations or milepost numbers were not furnished for the 23 samples.

Reported By:

Darrell Harding



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Federal Highway
Administration

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Report of Soil or Aggregate Tests

Project: Nevada PFH 31(1) Lamoille Canyon Road

Page 2 of 5

Submitted By: Joe Wilson

Date Reported: 10/30/2008

Sample Number	Lab Number	08-1278-SB	08-1279-SB	08-1280-SB	08-1281-SB	08-1282-SB
	Boring Number	B-16	B-17	B-18	B-24	B-26
	Bag Number	MC 7	MC 8	MC 10	MC 11	MC 12A
Sample Location	Station or Location					
	Offset	Right	Right	Right	Right	Right
	Depth Inches	8.5-18	6.5-24	6-42	6-42	6-30
AASHTO T 11, T 27 & T 88	3"	75.0 mm				
	1 1/2"	37.5 mm				
	1"	25.0 mm				
	3/4"	19.0 mm				
	1/2"	12.5 mm				
	3/8"	9.5 mm				
	#4	4.75 mm				
	#8	2.36 mm				
Washed Sieve Analysis % Passing	#10	2.00 mm				
	#16	1.18 mm				
	#30	600 µm				
	#40	425 µm				
	#50	300 µm				
	#100	150 µm				
	#200	75 µm				
		20 µm				
		2 µm				
		1 µm				
AASHTO T 255	Moisture, %	4.8	5.6	4.6	2.9	3.4
AASHTO T 89 & T 90	Liquid Limit					
	Plasticity Index					
Soil Classification	AASHTO M 145					
	ASTM D 2487					
AASHTO T 190	R -Value					
AASHTO T 288	Min. Resistivity, ohm-cm					
AASHTO T 289	pH					
AASHTO Method	Optimum Moisture, %					
	Maximum Dry Density, pcf					

Distribution:
Laboratory Num. / Project File
 Darrell Harding
QA Joe Wilson
Pavements Steve Deppmeier
Materials 1 Copy

Remarks:

Reported By:

Darrell Harding



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AASHTO R18 ISO/IEC 17025

Report of Soil or Aggregate Tests

Project: Nevada PFH 31(1) Lamoille Canyon Road

Page 3 of 5

Submitted By: Joe Wilson

Date Reported: 10/30/2008

Sample Number	Lab Number	08-1283-SB	08-1284-SB	08-1285-SB	08-1286-SB	08-1287-SB
	Hole Number	B-28	B-30	B-32	B-39	B-41
	Bag Number	MC 12	MC 13	MC 14	MC 15	MC 16
Sample Location	Station or Location					
	Offset	Right	Right	Right	Right	Right
	Depth Inches	7-24	6-18	7-12	7-36	7-15
AASHTO T 11, T 27 & T 88 Washed Sieve Analysis % Passing	3"	75.0 mm				
	1 1/2"	37.5 mm				
	1"	25.0 mm				100
	3/4"	19.0 mm				99
	1/2"	12.5 mm				93
	3/8"	9.5 mm				88
	#4	4.75 mm				78
	#8	2.36 mm				
	#10	2.00 mm				66
	#16	1.18 mm				58
	#30	600 µm				
	#40	425 µm				42
	#50	300 µm				
	#100	150 µm				27
	#200	75 µm				19
		20 µm				
		2 µm				
		1 µm				
AASHTO T 255	Moisture, %	4.1	3.9	3.3	2.6	6.0
AASHTO T 89 & T 90	Liquid Limit					NV
	Plasticity Index					NP
Soil Classification	AASHTO M 145					A-1-b (0)
	ASTM D 2487					SM
AASHTO T 190	R -Value					
AASHTO T 288	Min. Resistivity, ohm-cm					
AASHTO T 289	pH					
AASHTO Method	Optimum Moisture, %					
	Maximum Dry Density, pcf					

Distribution:
Laboratory Num. / Project File
 Darrell Harding
QA Joe Wilson
Pavements Steve Deppmeier
Materials 1 Copy

Remarks:

Reported By:

Darrell Harding



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AASHTO R18 ISO/IEC 17025

Report of Soil or Aggregate Tests

Project: Nevada PFH 31(1) Lamoille Canyon Road

Page 4 of 5

Submitted By: Joe Wilson

Date Reported: 10/30/2008

Sample Number	Lab Number	08-1288-SB	08-1289-SB	08-1290-RV	08-1291-RV	08-1292-RV
Sample Location	Station or Location					
	Offset	Right	Right			
	Depth Inches	7-18	7-18	8-24	7-60	6-42
AASHTO T 11, T 27 & T 88	3"	75.0 mm				
	1 1/2"	37.5 mm	100	100	100	100
	1"	25.0 mm	99	92	99	98
	3/4"	19.0 mm	96	88	99	96
	1/2"	12.5 mm	93	82	97	90
	3/8"	9.5 mm	89	78	96	85
	#4	4.75 mm	79	67	93	75
	#8	2.36 mm				
	#10	2.00 mm	66	58	87	63
	#16	1.18 mm	58	52	80	57
	#30	600 µm				
	#40	425 µm	44	42	66	45
	#50	300 µm				
	#100	150 µm	31	28	53	32
	#200	75 µm	23	20	46	24
		20 µm				
		2 µm				
		1 µm				
AASHTO T 255	Moisture, %	8.5	7.3			
AASHTO T 89 & T 90	Liquid Limit	NV	NV	33	26	22
	Plasticity Index	NP	NP	18	10	5
Soil Classification	AASHTO M 145	A-1-b (0)	A-1-b (0)	A-6 (4)	A-2-4	A-1-b (0)
	ASTM D 2487	SM	SM	SC	SC	SC-SM
AASHTO T 190	R -Value			6	25	35
AASHTO T 288	Min. Resistivity, ohm-cm					
AASHTO T 289	pH					
AASHTO Method	Optimum Moisture, %					
	Maximum Dry Density, pcf					

Distribution:
Laboratory Num. / Project File
 Darrell Harding
QA Joe Wilson
Pavements Steve Deppmeier
Materials 1 Copy

Remarks:

Reported By:

Darrell Harding



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Administration

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Report of Soil or Aggregate Tests

Project: Nevada PFH 31(1) Lamoille Canyon Road

Page 5 of 5

Submitted By: Joe Wilson

Date Reported: 10/30/2008

Sample Number	Lab Number	08-1293-RV	08-1294-RV	08-1295-RV		
	Hole Number	B-24	B-32	B-39		
	Bucket Number	4	5	6		
Sample Location	Station or Location					
	Offset					
	Depth Inches	6-42	7-24	7-36		
AASHTO T 11, T 27 & T 88 Washed Sieve Analysis % Passing	3"	75.0 mm				
	1 1/2"	37.5 mm	100	100	100	
	1"	25.0 mm	95	97	95	
	3/4"	19.0 mm	89	90	89	
	1/2"	12.5 mm	79	82	80	
	3/8"	9.5 mm	73	77	74	
	#4	4.75 mm	58	66	59	
	#8	2.36 mm				
	#10	2.00 mm	47	56	48	
	#16	1.18 mm	41	50	42	
	#30	600 µm				
	#40	425 µm	29	36	31	
	#50	300 µm				
	#100	150 µm	17	19	19	
	#200	75 µm	11	11	12	
		20 µm				
		2 µm				
		1 µm				
AASHTO T 255	Moisture, %					
AASHTO T 89 & T 90	Liquid Limit		NV	NV	NV	
	Plasticity Index		NP	NP	NP	
Soil Classification	AASHTO M 145		A-1-a (0)	A-1-b (0)	A-1-b (0)	
	ASTM D 2487		SP-SM	SP-SM	SP-SM	
AASHTO T 190	R -Value		74	73	75	
AASHTO T 288	Min. Resistivity, ohm-cm					
AASHTO T 289	pH					
AASHTO Method	Optimum Moisture, %					
	Maximum Dry Density, pcf					

Distribution:
Laboratory Num. / Project File
 Darrell Harding
QA Joe Wilson
Pavements Steve Deppmeier
Materials 1 Copy

Remarks:

Reported By:

Darrell Harding

APPENDIX C – Photographs

NVPFH 31(1) Lamoille Canyon Road

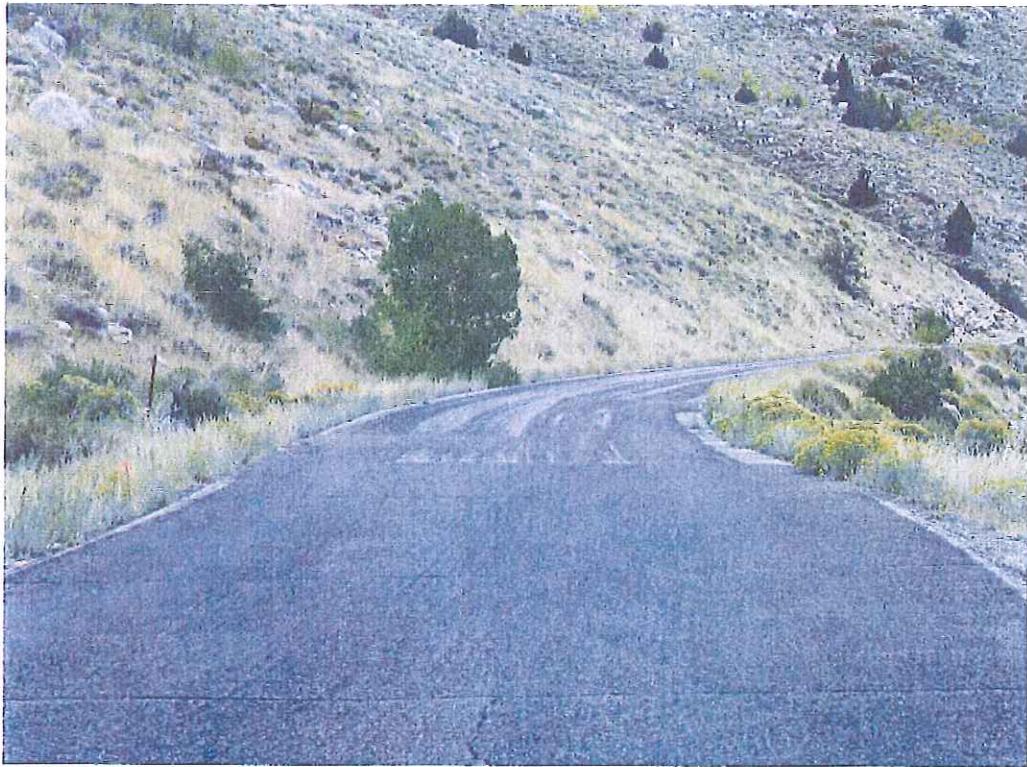


Entrance to Lamoille Canyon, Boring 2



Transverse cracking on entrance road to Lamoille Canyon

NV PFH 31(I) Lamoille Canyon Road

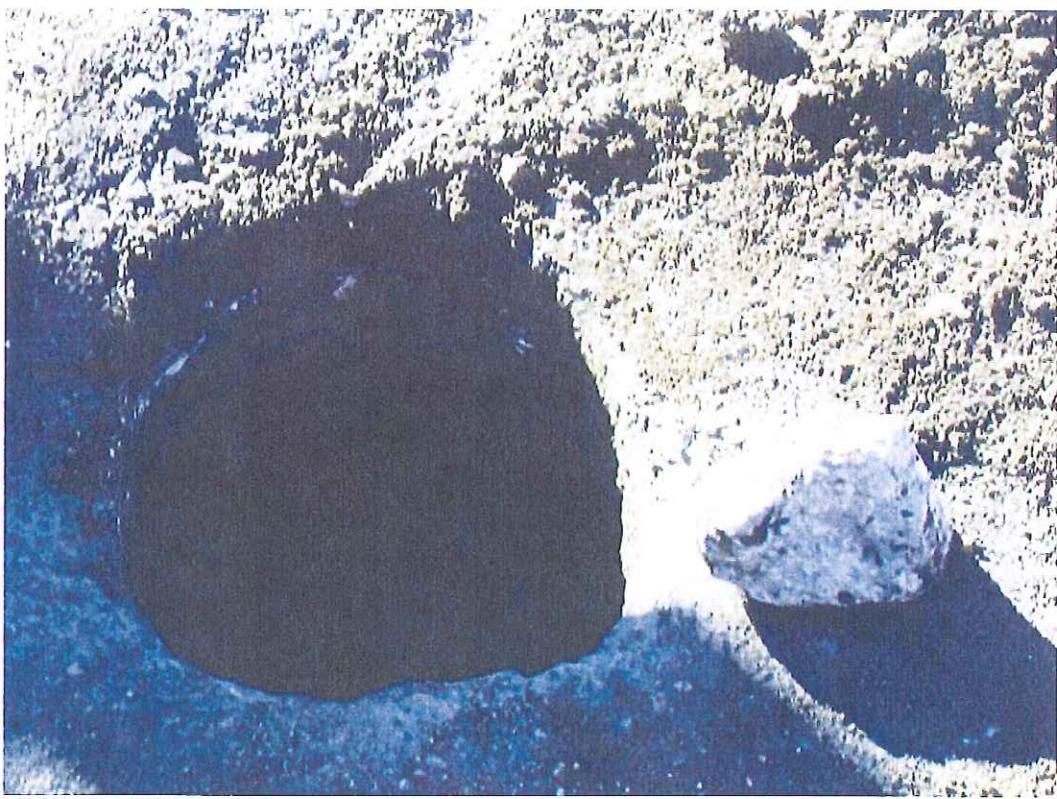


~MP-1.75, typical transition between surface treatments, just after entrance to picnic area.



MP-4.25, one of many locations that had large cobbles just below HACP

NV PFH 31(1) Lamoille Canyon Road

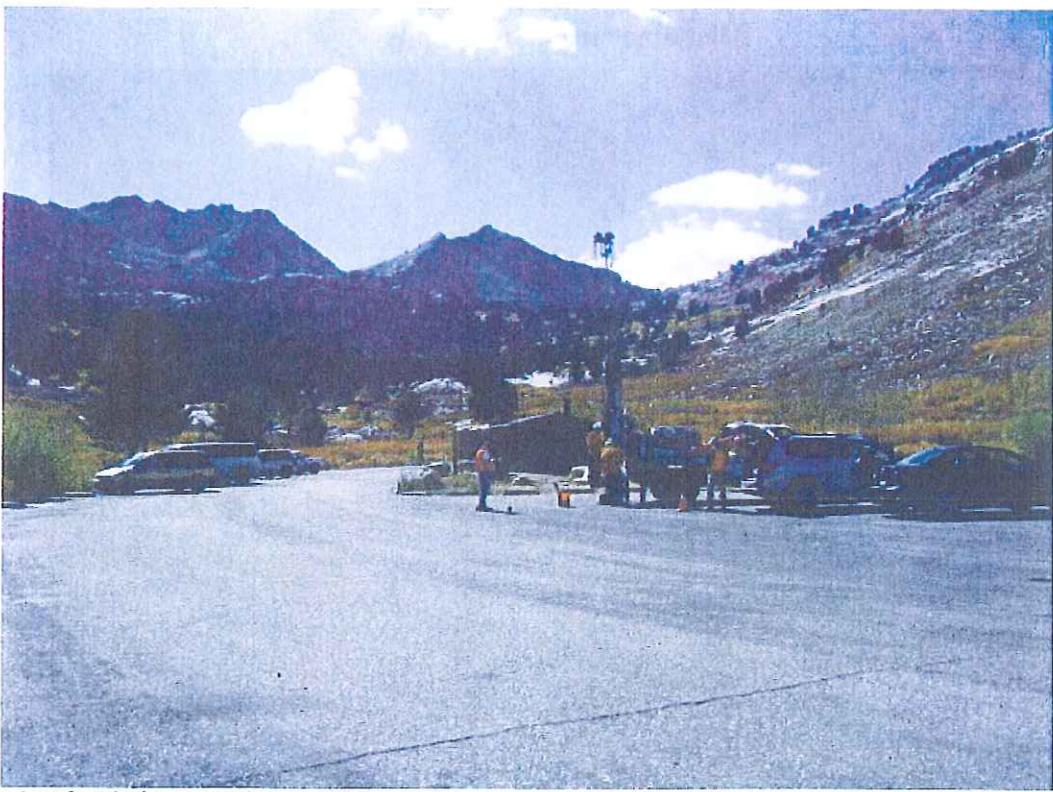


Cobbles located below HACP



Cobbles located below HACP

NV PFH 31(1) Lamoille Canyon Road



One of two borings at top of canyon parking lot

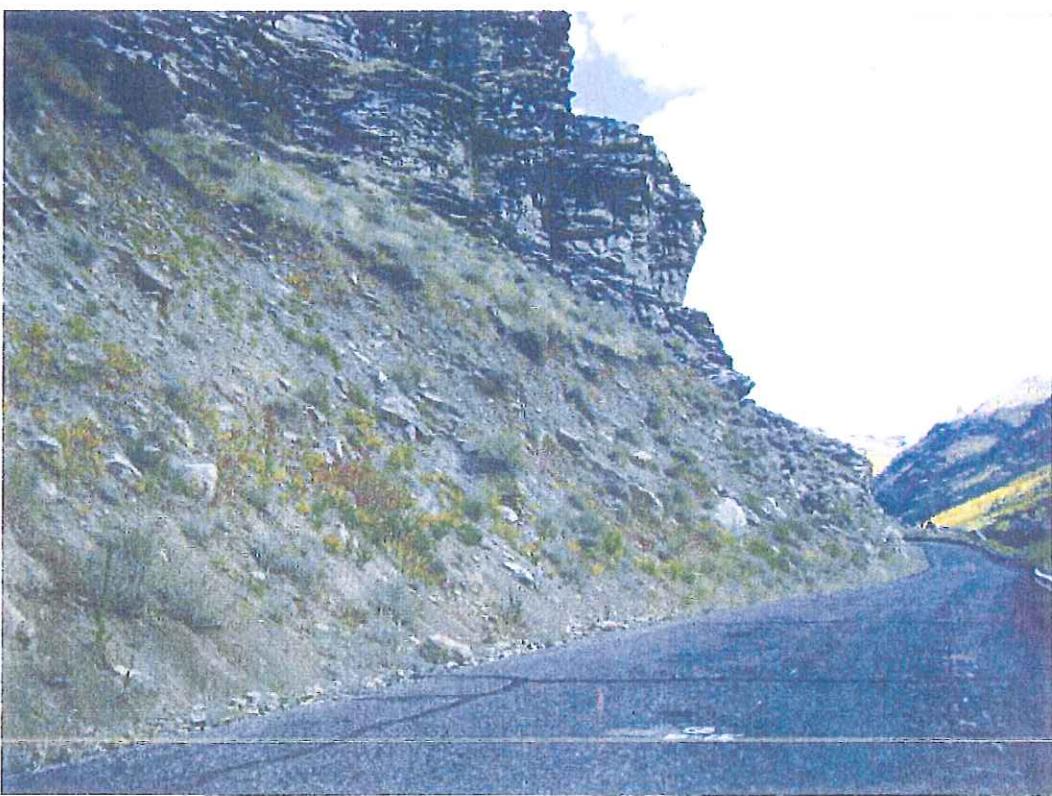


Geotechnical Boring 46

Miscellaneous Photographs



NV PFH 31(1) Lamoille Canyon Road



APPENDIX D – DARWin Pavement Design

1993 AASHTO Pavement Design
 DARWin Pavement Design and Analysis System
 A Proprietary AASHTOWare
 Computer Software Product
 Flexible Structural Design Module

NV PFH 31(1) Lamoille Canyon Road
 NV 227 Intersection to MP-1.75

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	51,793
Initial Serviceability	4.2
Terminal Serviceability	2
Reliability Level	75 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	3,126 psi
Stage Construction	1
Calculated Design Structural Number	2.65 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	350
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
2	50	1	0.0004	0	280
3	45	1	0.004	0	2,520
5	3	1	0.5	0	20,997
6	2	1	1	0	27,996
Total	100	-	-	-	51,793
Growth			Simple		
Total Calculated Cumulative ESALs			51,793		

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HACP	0.44	1	4	-	1.76
2	Pulverize	0.12	1	6	-	0.72
3	Existing Sand/Gravel	0.08	1	2	-	0.16
Total	-	-	-	12.00	-	2.64

1993 AASHTO Pavement Design
 DARWin Pavement Design and Analysis System
 A Proprietary AASHTOWare
 Computer Software Product

Flexible Structural Design Module

NV PFH 31(1) Lamoille Canyon Road
 MP-1.75 to MP-5.0

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	51,793
Initial Serviceability	4.2
Terminal Serviceability	2
Reliability Level	75 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	6,849 psi
Stage Construction	1
Calculated Design Structural Number	1.98 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	350
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %

Vehicle Class	Percent of ADT	Annual Growth	Average Initial Truck Factor (ESALs/Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
2	50	1	0.0004	0	280
3	45	1	0.004	0	2,520
4	3	1	0.5	0	20,997
5	2	1	1	0	27,996
Total	100	-	-	-	51,793
Growth			Simple		
Total Calculated Cumulative ESALs			51,793		

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HACP	0.44	1	3	-	1.32
2	Pulverize	0.12	1	6	-	0.72
Total	-	-	-	9.00	-	2.04

1993 AASHTO Pavement Design
 DARWin Pavement Design and Analysis System
 A Proprietary AASHTOWare
 Computer Software Product
 Flexible Structural Design Module

NV PFH 31(1) Lamoille Canyon Road
 MP-5.0 to End of Project

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	51,793
Initial Serviceability	4.2
Terminal Serviceability	2
Reliability Level	75 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	18,259 psi
Stage Construction	1
Calculated Design Structural Number	1.33 in

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	350
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
			Truck Factor (ESALs/Truck)		
2	50	1	0.0004	0	280
3	45	1	0.004	0	2,520
4	3	1	0.5	0	20,997
5	2	1	1	0	27,996
Total	100	-	-	-	51,793

Growth	Simple
Total Calculated Cumulative ESALs	51,793

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HACP	0.44	1	2	-	0.88
2	Pulverize	0.12	1	6	-	0.72
Total	-	-	-	8.00	-	1.60

APPENDIX E – PG LTPPBIND Software

NV PFH 31(1) Lamoille Canyon Road

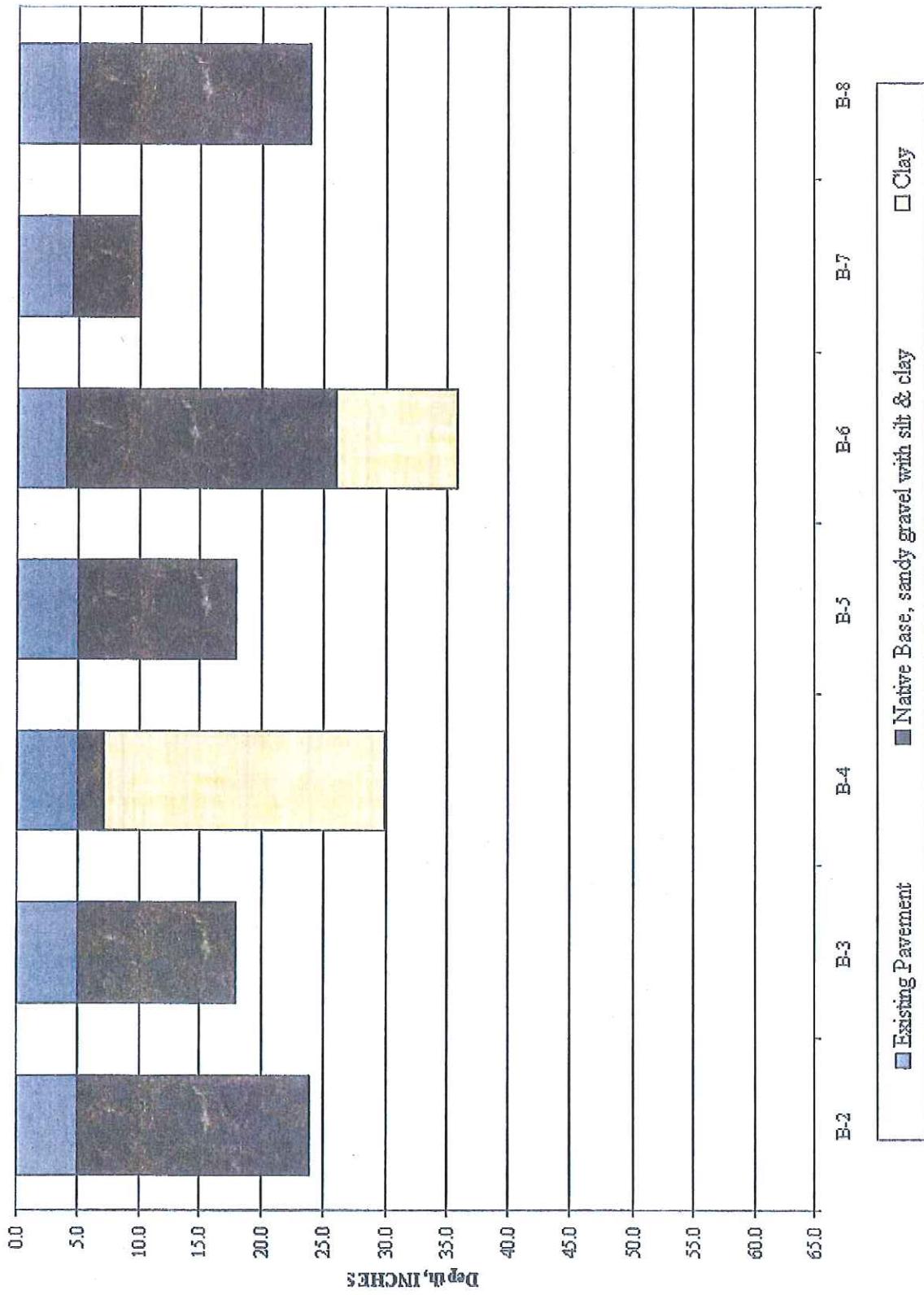
Report - 103 Selected Weather Stations

State/Province		NV			
Weather Station		LAMOILLE MILLER RANC			
Station ID	NV4394		Latitude	40.72	
County / District	ELKO		Longitude	115.52	
Last Year Data Avail.	1997		Elevation, m	1653	
Air Temperature	Mean	Std Dev	Min	Max	Years
High Air Temperature, Deg. C	32.4	1.1	30.1	35.1	22
Low Air Temperature, Deg. C	-23.9	2.9	-30.5	-19	21
Low Air Temp. Drop, Deg. C	27.2	2.9	23.5	32.5	21
Degree Days over 10 Deg. C	2422	211	1965	2790	22
Pavement Temperature and PG	HIGH	LOW	High Rel	Low Rel	
50% Reliability Pvt Temp., C	51.5	-16.6	50	50	
>50% Reliability PG	52	-22	68	96	
	58	-22	98	96	
	58	-28	98	98	
?	PG Chart	PG Distribution	Save	Cancel	

APPENDIX F – Visual Classification Summary

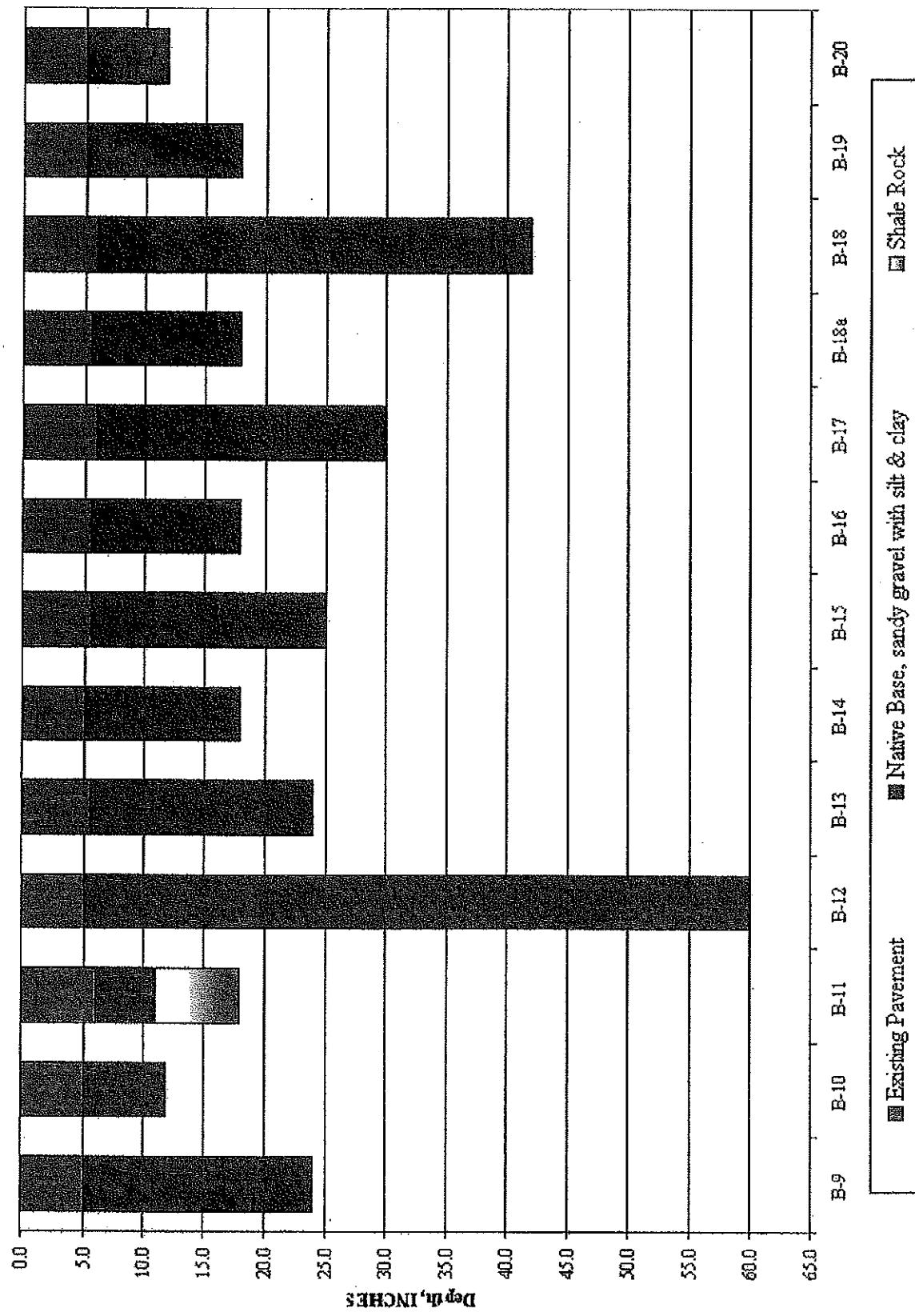
NV PFH 31(1) Lamoille Canyon Road

NV 227 Intersection to MP-1.75
Design Resilient Modulus = 3,126 psi



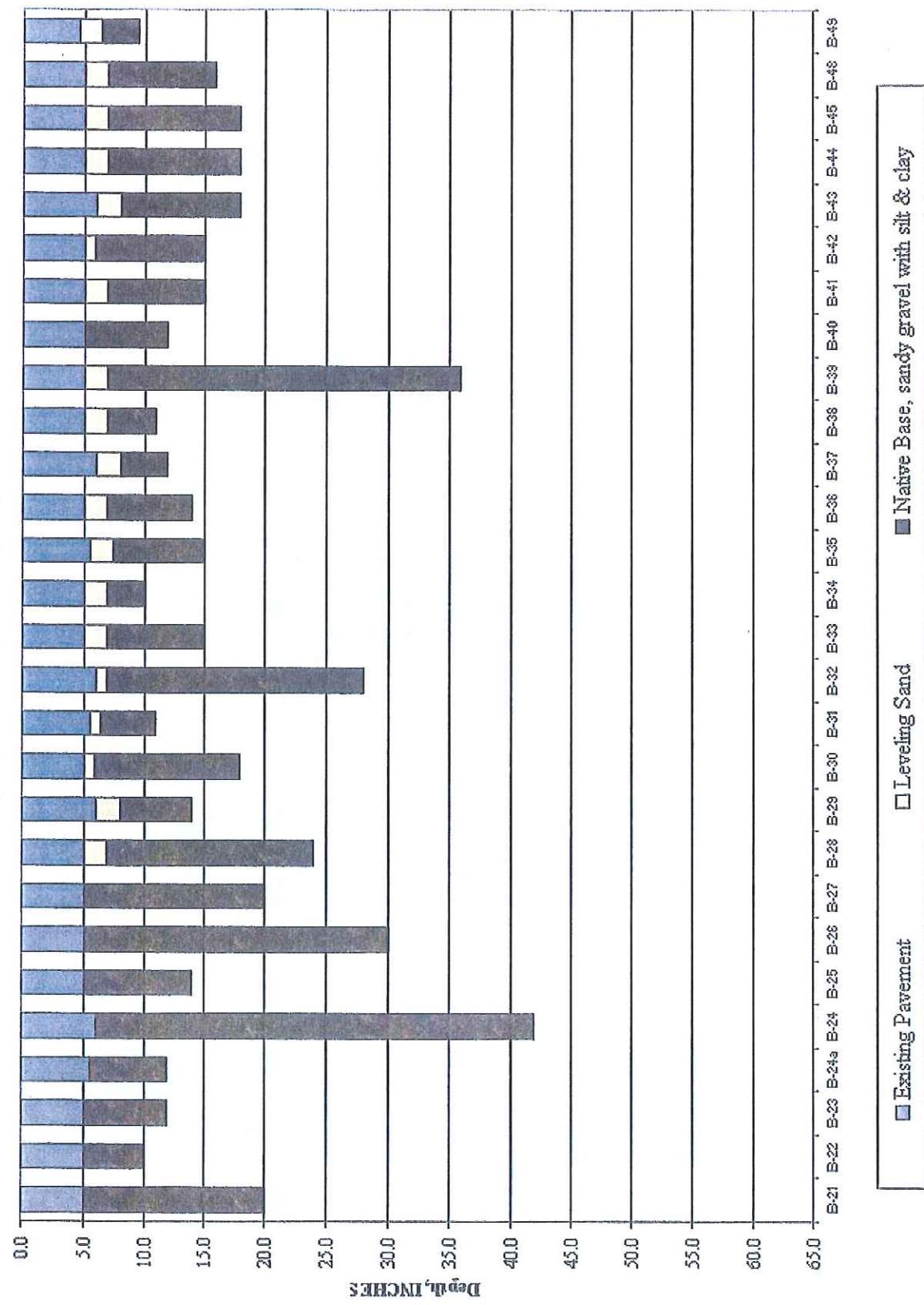
NV PFH 31(1) Lamoille Canyon Road

MP 1.75 - MP 5.00
Design Resilient Modulus = 6,849 psi



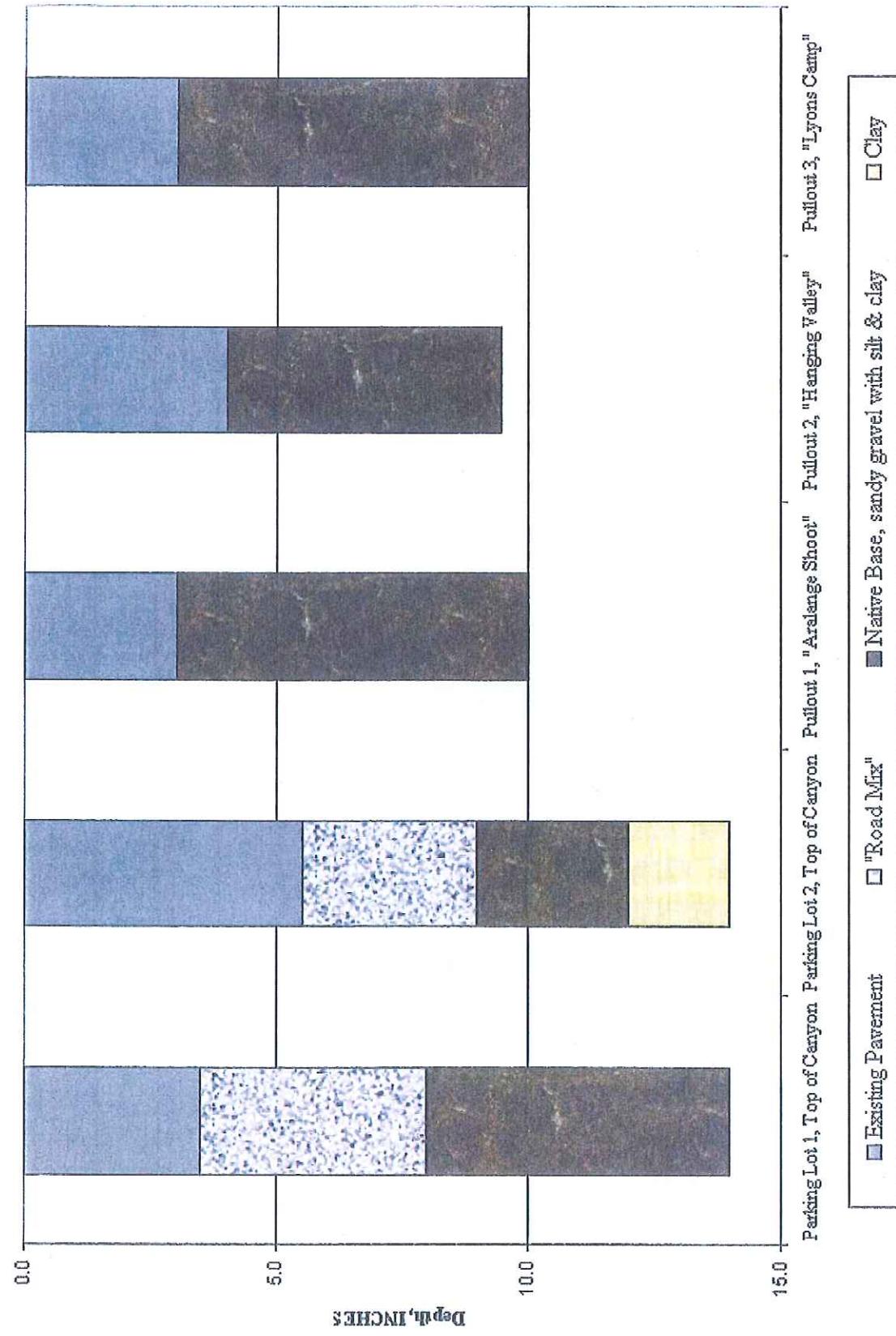
NV PFH 31(1) Lamoille Canyon Road

MP 5.00 - End of Project
Design Resilient Modulus = 18,259 psi



NV PFH 31(1) Lamoille Canyon Road

Parking Lots and Pullouts



APPENDIX G - Price Estimations and Assumptions

LAMOILLE CANYON		\$ 4,300,000.00	*	0.7	=	\$3,010,000
average hacc average hacc	width depth	25.00 5.00	feet inches			
6" Pulverize	25.00	x 5,280.00	= 132,000.00	sq feet	/	9
2" HACP	25.00	x 5,280.00	x 0.167	x	145	/
3" HACP	25.00	x 5,280.00	x 0.25	x	145	/
4" HACP	25.00	x 5,280.00	x 0.33	x	145	/
4" CIPR	25.00	x 5,280.00	x 0.33	x	145	/
CIPRs HFMS-2sp	25.00	x 5,280.00	x 0.33	x	145	/
Tack	5,280	x 25	x 0.1111	=	14,665	x
Fog	5,280	x 25	x 0.1111	=	14,665	x
Prime	5,280	x 25	x 0.1111	=	14,665	x
Blotter	5,280	x 25	x 0.1111	=	14,665	x
Crack Seal						
Pavement Patching	5,280	x 25	x 0.1111	=	14,665	x
Chip, Designation 1C	5,280	x 25	x 0.1111	=	14,665	x
Emulsified Asphalt, Grade CRS-2p	5,280	x 25	x 0.1111	=	14,665	x
Chip, Designation 2B	5,280	x 25	x 0.1111	=	14,665	x
Emulsified Asphalt, Grade CRS-2p	5,280	x 25	x 0.1111	=	14,665	x
Segment #1	4" HACP + 6" FDR - Pulverizing	\$447,177	per mile	Proposed length	1.75	x \$447,177 = \$782,560.36
Segment #2	3" HACP + 8" FDR - Pulverizing	\$362,961	per mile	Proposed length	24	x 14,665 = \$341,904
Segment #3	Crack Seal + Chip Seal + Pavement Patching	\$70,137	per mile	Proposed length	55	x 14,665 = \$806,389
Alternative: Segment #4	Double Chip Seal + 6" Pulverize	\$190,984	per mile	total	7.3	x \$70,137 = \$512,000.28
Alternative: 4" CIPR	Double Chip + 4" CIPR	\$208,522	per mile		12.3	
Alternative: 3" HACP on 4" CIPR	3" HACP + 4" CIPR	\$381,500	per mile			

APPENDIX H – Preliminary Pavements Memo



Memorandum

Subject: **NV PFH 31(1) LAMOILLE CANYON ROAD**
PRELIMINARY PAVEMENT RECOMMENDATION

Date: 12-11-2008

From: Steve Deppmeier, Pavements Engineer
Joe Wilson, Materials Quality Assurance

To: Allen Grasmick, Project Manager
Ryan Olson, Lead Designer

Lamoille Canyon Road project is approximately 12.3 miles long, and will be rehabilitated. The traffic loading is 52,000 ESALs from an ADT of 350. The existing pavement is 4 inches to 6 inches in depth, with an average of 5 inches, typically placed on 2 inches of a sandy leveling course. Based on the varying subgrade soils, the project was broken into three sections. The recommended pavement structural sections are:

NV 227 Intersection to Pullout (MP-1.75)

Roadbed Resilient Modulus = 3,000 psi (design R-Value = 5)

Existing HACP thickness = 4.75 inches

Minimum combined existing HACP and leveling course = 7 inches

4 inches HACP

6 inches FDR – Pulverize

Grade Raise = 4 inches

Cost Estimate = \$450,000 per mile, paving cost only

Pullout at (MP-1.75) to ~ turnout (MP-5.0)

Roadbed Resilient Modulus = 6,800 psi (design R-Value = 30)

Existing HACP thickness = 5.75 inches

Minimum combined existing HACP and leveling course = 11 inches

3 inches HACP

6 inches FDR – Pulverize

Grade Raise = 3 inches

Cost Estimate = \$340,000 per mile, paving cost only

~Turnout (MP-5.0) to End of Project

Roadbed Resilient Modulus = 18,000 psi (R-Value = 60)

Crack Seal

Pavement Patching in spot locations

Chip Seal

Grade Raise = 0

Cost Estimate = \$73,000 per mile, paving cost only



Due to funding constraints, an alternative to a 20-year design was requested to be explored. The option below would typically have a service life of 3 to 7 years with risks of localized failures occurring in the first year of placement. This risk should be clearly communicated to the partner agencies.

Alternative non 20-year Design Option

Double Chip Seal

6 inches FDR – Pulverize

Grade Raise = $\frac{3}{4}$ inches

Cost Estimate = \$195,000 per mile, paving cost only

Shallow bedrock does exist at numerous locations as well as cobbles at depths typically beneath the leveling course. A note of caution should clearly state on the typical plan sheet the near surface cobbles and shallow bedrock as these could impact the pulverization process.

Pavement Materials

- HACP should be 40201-4800, Hot Asphalt Concrete Pavement, Hveem Test, Class C, Grading C or E. Estimate at 145 lb/ft³. Type III Roughness should be specified.
- Antistrip will be Type III (Hydrated Lime) at 1%.
- Asphalt cement will be PG 64-28NV. Estimate at 6.0 % by weight of mix.
- HACP shall be placed in two lifts with a Tack Coat between lifts. Use an emulsion CSS-1, CSS-1h, SS-1, or SS-1h at 0.1 gal/yd².
- Include a Fog Seal. Use an emulsion CSS-1, CSS-1h, SS-1, or SS-1h at 0.1 gal/yd².
- Include a Prime Coat, applied to the FDR – Pulverized material prior to paving. Use bid Item 41101-0000. An item for blotter control, 41105-0000 should be included at 14.75lb/ft².

CC: Mike Peabody, Materials Engineer
Richard Duval, QA Engineer
Ron Andresen, QA Engineer
Construction Branch
Project Files

Attachment: DARWin Pavement Calculation
LTPPBInd
Cost Estimate

